Faculty of Science Centenary Dinner

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Congratulations by Dr Thomas auf der Heyde, Deputy Director General: Research Development and Support, Department of Science and Technology, South Africa

On the state of the basic sciences in South Africa

The basic sciences are the building blocks for applied science and technology, and training schools for the PhD-level researchers required for a knowledge-intense, innovation-driven economy. In recent years, the Department of Science and Technology (DST) has invested significantly in a wide range of technology development initiatives in biotechnology, advanced manufacturing, battery technologies, and nanotechnology, for example. Success in many of these initiatives has given rise to a concern that the DST may be prioritizing applied sciences over the basic ones, to the long-term detriment of science in South Africa. These fears are not consistent with the evidence.

Between 2010/11 and 2018/19, the DST budget increased by 88.7%, but that of the National Research Foundation (NRF) – increased by 152%. The proportion of the DST budget allocated to the NRF increased from 35% to 47% over this period. In proportion to the overall DST investment in sience and technology, investment in basic science therefore increased significantly. A significant proportion of this increase is accounted for by the cost of the SKA/MeerKAT project, which constitutes an investment in a range of basic sciences like physics, astronomy, and computer science, notwithstanding the exciting new technologies that are beginning to emerge from this project, and the major boost it has given to South African engineering.

The investment especially in astronomy over the last 10 years is predicated on the strategic decision made by the DST in 2004 to develop those areas of science in which South Africa enjoyed a geographic advantage such as astronomy (clear, dust and radio-free skies), and palaeosciences (the Cradle of Humankind). This strategic choice has yielded significant scientific returns for the relevant sciences, with South Africa becoming increasingly competitive on the global stage, but it might have been accompanied by a reduction in other important basic sciences. Consequently, we now need to assess soberly the state of the key basic sciences as a whole, to formulate appropriate policy for this important area of the national science and technology enterprise.

Toward this end, the DST has commissioned a more detailed assessment of the state of science in South Africa from the Centre for Research on Science, Technology and Evaluation (CREST), at Stellenbosch University. The CREST report is not yet finalized, but the provisional results are beginning to reveal important, enlightening and encouraging results, which will certainly over time shape policy for supporting the basic sciences in South Africa – and will provide an objective base for making difficult choices that will likely be required in due course.

Computer science is an important discipline accompanying the increasing computational demands not only of modern science, but also of the economy; big data is ubiquitous in science and business. Although South African scientific publications in this field have approximately doubled over the last decade, they contribute only about 0,3% to the global output, less than the average 0,8% contribution made by South African science to global production. Moreover, South Africa's rank in terms of total output has dropped from 37th in 2005 to 51st in 2016, and the overall national strength of computer science regressed during this period, though in some sub-fields there has been some improvement. Given the centrality of big data and computational skills and capacity to modern science and the economy, we will need to consider appropriate policy interventions urgently, in conjunction with relevant private sector stakeholders such as the financial services and ICT sectors.

Very interesting changes occurred in the field of physics over the period 2005-2016; the impact, as measure by citations, of South African papers in the sub-fields of nuclear, particle and field physics increased from just over to between 2.5 and three times the global average, while the overall standing of work in applied, fluid, plasma, atomic and mathematical physics remained unchanged. It is likely that the relative strengthening of nuclear-related physics is coupled to the DST strategy of strengthening links to the European Nuclear Research Centre (CERN) and the Joint Institute for Nuclear Research (JINR) in Russia, especially over the last half decade.

The need to strengthen computer science and the opportunity to capitalize on the strengths of the relevant sub-fields of physics in South Africa play an important role in current discussions about the feasibility of establishing a national institute for computational and theoretical sciences, with the current National Institute for Theoretical Physics as its core.

Over the 2005-2016 period, scientific output in the field of Astronomy and Astrophysics increased five-fold, moving from a contribution of 0.75% to global output in the field, to almost 3%, far in excess of the average global contribution by South African science of 0,8%. Moreover, the impact of these publications is almost three times the global average impact of papers in the field, and almost 90% of multi-authored papers are produced with international partners. Of course, these very positive changes are closely linked to the strategic prioritization of astronomy and the consequent and consistent national investment made in it. All indications are that the national multi-wavelength astronomy strategy being implemented through our world-class astronomy infrastructure will further enhance the status of this basic discipline in South Africa.

Lastly, the status of the geological sciences is important because of their link to the mining sector in South Africa. Although output more than doubled during the above period, the relative contribution of this field to South African science has decreased by about 16% over the above period. Despite this decline, it appears the quality or strength of South African geological research has not diminished, as its contribution to global output remained around 1% throughout, its rank globally remained at around 30, higher than for most other fields, and its impact remained above the global average. The

data therefore suggest that while South Africa retinas important capacity for geological research, signs of stagnation or contraction are discernible. This is of concern, given the socio-economic importance of the mining sector and the broad agreement that technological renewal of this sector is essential.

Careful analysis of our science enterprise can provide critical insight into its strengths and weakness, enabling the development of policies and interventions aimed at optimizing the contribution of basic sciences in South Africa to our national needs and opportunities.

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